Technology Fact Sheet
Selective Separation Cartridge™ Technology

Savannah River Site
In Partnership with the Office of Science & Technology

Introduction

In 1992, the last of the five U.S. Department of Energy production reactors at the Savannah River Site was placed into shutdown mode, with no intention to restart. With this action, the site entered into an extensive deactivation and long-term surveillance and maintenance life-cycle phase of these facilities.

The integrity of the aging facilities has become a concern in recent years, including the potential seepage from the reactor disassembly basins into the surrounding groundwater. Efforts to address this concern have been initiated and are being incorporated into the overall facility deactivation and decommissioning planning strategy.

EM's Office of Science and Technology (OST) has partnered with the Savannah River Site (SRS) in an Accelerated Site Technology Deployment (ASTD) project to remove select radionuclides from over 5 million gallons of water at the R-Reactor Disassembly Basin. OST initially provided funding to deploy Selion/Graver's NURES technology in the ASTD project. Recognizing an opportunity to enhance the basin cleanup activity, the Deactivation and Decommissioning Focus Area (DDFA) engaged SRS to integrate 3M's Selective Separation Cartridge™ (SSC) technology into the ASTD project. Deployment of the SSC will substantially contribute to closure of the disassembly basin, reduce costs by $4 - $6 million, and complete the work 5-7 years sooner compared to the site's baseline.

Technical Need

Much of the radionuclide-containing wastes that were left behind from nuclear weapons production exist in aqueous form. Additional aqueous waste is continually being generated from groundwater remediation and decommissioning activities. Large volumes of contaminated water exist at various facilities at SRS (for example, fuel storage and disassembly basins). Current treatment of this water requires removal of the water from the basins and shipment to the F and H Area Effluent Treatment Facility (ETF).

With the uncertainty of the integrity of the basins over time, a technology that can remove radioactive contamination from the water while minimizing secondary waste generation is essential to the success of the remediation of the reactor basins. A technology that is cost-effective and safe is needed to process the basin waters on location without transporting the water to ETF. The technology must reduce targeted nuclides to near DOE release limits and condition the water for direct release.

System Description

The Selective Separation Cartridge™, based on an innovative membrane technology developed by 3M with OST support, is designed to remove specific radionuclides from aqueous solutions at high flow rates. This is an efficient technology for the treatment of these wastes and it is capable of removing various radionuclides to EPA drinking water standards.

Selective Separation Cartridge™ System

The membrane, termed the WWL™, is fabricated into a spiral-wound, cartridge-filter. The trademarked identification WWL™ is used to differentiate the cartridge membrane from an analytical sampling membrane designated Empore™, which was also developed with OST support.

The membrane is unique in that it is made up of sorbent particles that are loaded or enmeshed onto a web or membrane. The cartridges are approximately 3 in. in diameter by 10 in. long and can be operated singly or in "nested" arrangement for higher flow rates. Several classes of materials have been successfully incorporated into the 3M membranes, including commercial ion-

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exchange materials, inorganic adsorbents, unique zeolite structures, and sophisticated macrocyclic molecular recognition compounds.

WWL™ Spiral-Wound, Cartridge-Filter

The SSC have the following characteristics:

- high separation efficiencies
- high radionuclide loading
- high flow rates
- fast reaction kinetics
- physical ruggedness
- compact size with small system footprint
- cost effective treatment

Membranes have been developed for removal of the following contaminants:

- Cs, Tc, Sr, Co, Pb, and Cu
- U and Pu (under development)

Benefits

3M's selective separation membranes have several advantages over the baseline technology conventional sorbent columns:

- Small (5-80µm), high surface-area, particles can be incorporated into membranes which increases capacity per unit volume (NOTE: particles of this size would result in unacceptable back-pressure if used in columns)
- Faster flow rates than standard ion exchange columns while achieving equal extraction efficiencies results in reduced decontamination time
- Channeling, which can be a severe limitation for columns, is absent in membranes type systems
- The footprint of the cartridge system is small compared to most columns
- Capital cost is significantly less than the baseline technology (NOTE: The cost of any system is highly dependent on site conditions. Specifically, the presence of competing ions in a wastewater stream has a significant impact on the useful life of the system, which ultimately affects cost)

Status

The SSC technology was deployed in May 2000 at the R-Disassembly Basin. Initially, Strontium was the targeted radionuclide, and the system processed tens of thousands of gallons at 20 gpm. Two slightly different types of cartridges were utilized during the startup phase of the deployment. Presently, the system is operating with cartridges that remove Cesium. Cs removal from the water is scheduled for eight weeks at 20 gpm.

The schedule for continuing deployment of 3M's SSC technology is:

- Continue operation of the system at R-Basin for the capture and removal of Cesium at flow rates of 20 gpm through August 2000.
- Then operate the SSC technology in parallel with the Graver/Selion water treatment technology ("NURES"; an ASTD project) for ~ 6-8 months to bring Cesium and Strontium contaminant levels down to near release limits.

Deploying the 3M SSC technology alongside NURES allows water treatment at higher flow rates, i.e., ~ 40 gpm, which in turn will allow accelerated closure of the disassembly basin. Subsequent to water treatment at R-Basin, the technology is expected to be deployed at SRS' "C" and "P" Reactor Disassembly Basins, and at other similar water processing projects across the DOE complex.

For more information about deployment of the Selective Separation Cartridge™ System at the Savannah River Site

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